The chiton stripe tease

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The chiton stripe tease

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The chiton *Tonicella lineata* (Wood, 1815) is distinctive for its vivid colouration and striking patterns of colour blocks and stripes. The kaleidoscopic colours of this species is a familiar feature of the NE Pacific coastal fauna. Despite extensive study of the biology of *Tonicella* spp., their colour and patterns have never been the subject of rigorous investigation; thus, a few key preliminary observations are documented here. Shell colours in *Tonicella* spp. are anecdotally presumed to be derived from their primary diet of coralline algae (Piercy 1987), but this has not been tested chemically to date. Some pigments are evidentially unstable as the colours, particularly blue and pale pink, fade extremely rapidly in preserved specimens or around the site of shell breakage injuries in living animals (Fig. 1a, cf. image at upper right). *Tonicella lineata* range in shade from dark red, to pink, orange, purple or cyan blue, with an underlying pattern of divergent diagonal banding composed of these colours, faintly present even when the valve colour appears superficially solid (Fig. 1a, *cf.* image at the centre, which is solid blue). Consistent differences in patterning have been used as one feature of taxonomic separation of species within the genus (Clark 1999). But there is also finer-level variation, and examination of photo datasets for *T. lineata* across its geographic range showed that these patterns are unique at the individual level, in the same way as other natural patterns, from snowflakes to zebras. Even between specimens that have apparently similar ornamental patterns, close examination will find differences on at least one shell valve (Fig. 1a, cf. images in the lower row).

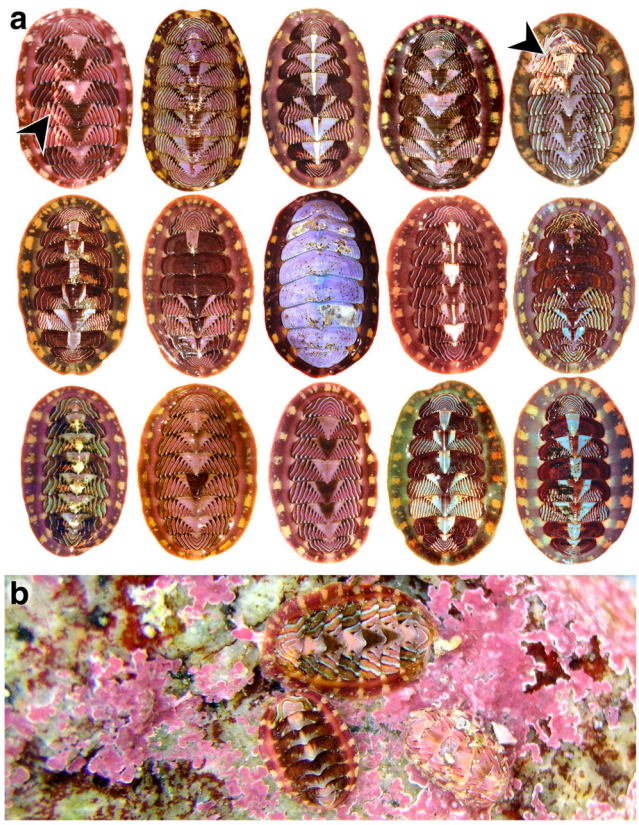

Fig. 1 Colour patterning in *Tonicella lineata*. **a** Individual variation among 15 live animals, showing shell colours without any encrusting epibiota. The *arrowheads* indicate areas of pigment bleaching in vivo around shell breakages. **b** Effective camouflage of three live animals on encrusting coralline algae. Animals collected and photographed in (**a**) Friday Harbor, San Juan Island, USA and (**b**) Bamfield, British Columbia, Canada

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Mathematical models of diffraction patterns describe the shell patterning in many molluscs (Field and Golubitsky 2009), but this has never been applied to the eight-shelled chiton armature. Combinations of striping and blocks on the shells and girdle of *Tonicella* may represent a 'maximum disruptive contrast' camouflage (Fig. 1b), which confounds edge detection mechanisms that are fundamental even in simple visual systems (Stevens and Cuthill 2006). This could be effective against likely chiton predators, including crabs and fish. Previous studies have noted the population-level advantage of colour polymorphisms camouflage in chitons (e.g. Goncalves Rodrigues and Silva Absalão 2005). The defensive stripes on each *T. lineata* represent a sophisticated visual defence in animals with no eyes themselves.

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